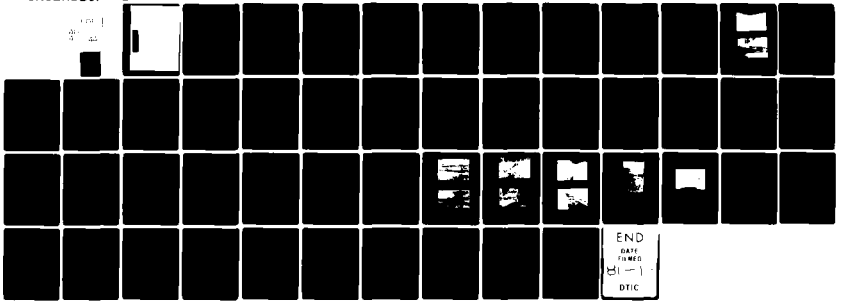
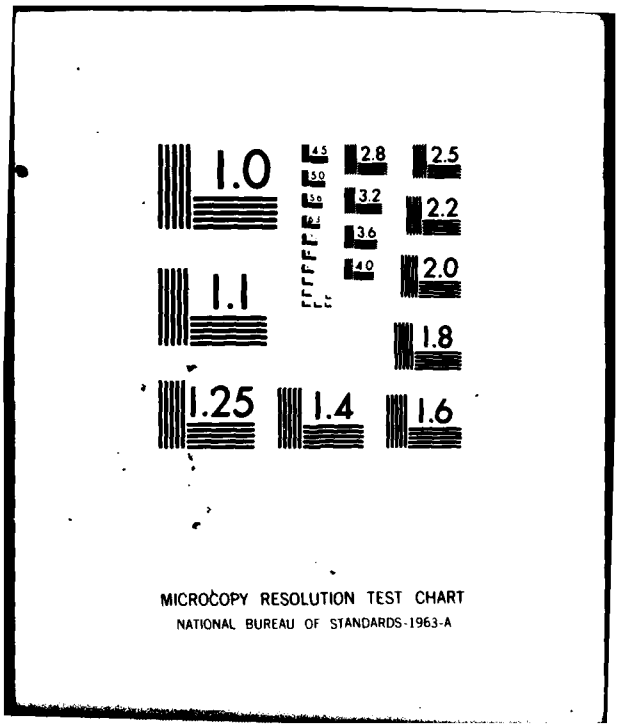
AD-A091 441 SCHNABEL ENGINEERING ASSOCIATES RICHMOND VA F/G 13/13
NATIONAL DAM SAFETY PROGRAM. AVIATION, GOLF AND FARM CLUB DAM, --ETC(U)
JUL 80 R E MARTIN DACW65-79-D-0004
UNCLASSIFIED NL




1.0
1.1
1.25
1.4
1.6
1.8
2.0
2.2
2.5
2.8
3.2
3.6
4.0
4.5
5.0
5.6
MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER VA 01703	2. GOVT ACCESSION NO. AD-A091 441	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) Phase I Inspection Report National Dam Safety Program Aviation. Golf and Farm Club Dam Bath County, Virginia		5. TYPE OF REPORT & PERIOD COVERED Final 6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) Schnabel Engineering Associates. P.C./ J. K. Timmons and Associates. Inc.		8. CONTRACT OR GRANT NUMBER(s) ✓DACW 65-79-C-0004
9. PERFORMING ORGANIZATION NAME AND ADDRESS		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
11. CONTROLLING OFFICE NAME AND ADDRESS U. S. Army Engineering District, Norfolk 803 Front Street Norfolk, Virginia 23510		12. REPORT DATE July 1980 13. NUMBER OF PAGES
14. MONITORING AGENCY NAME & ADDRESS(if different from Controlling Office)		15. SECURITY CLASS. (of this report) Unclassified 15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT (of this Report)

Approved for public release; distribution unlimited.

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

18. SUPPLEMENTARY NOTES

Copies are obtainable from National Technical Information Service,
Springfield, Virginia 22151

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Dams - VA
National Dam Safety Program Phase I
Dam Safety
Dam Inspection

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

(See reverse side)

DD FORM 1 JAN 73 1473 EDITION OF 1 NOV 65 IS OBSOLETE

Unclassified

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

20. Abstract

Pursuant to Public Law 92-367, Phase I Inspection Reports are prepared under guidance contained in the recommended guidelines for safety inspection of dams, published by the Office of Chief of Engineers, Washington, D. C. 20314. The purpose of a Phase I investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general conditions of the dam is based upon available data and visual inspections. Detailed investigation and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I investigation; however, the investigation is intended to identify any need for such studies.

Based upon the field conditions at the time of the field inspection and all available engineering data, the Phase I report addresses the hydraulic, hydrologic, geologic, geotechnic, and structural aspects of the dam. The engineering techniques employed give a reasonably accurate assessment of the conditions of the dam. It should be realized that certain engineering aspects cannot be fully analyzed during a Phase I inspection. Assessment and remedial measures in the report include the requirements of additional indepth study when necessary.

Phase I reports include project information of the dam and appurtenances, all existing engineering data, operational procedures, hydraulic/hydrologic data of the watershed, dam stability, visual inspection report and an assessment including required remedial measures.

JAMES RIVER BASIN

NAME OF DAM: AVIATION, GOLF AND FARM CLUB DAM
LOCATION: BATH COUNTY, VIRGINIA
INVENTORY NUMBER: VA. NO. 01703

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

PREPARED FOR
NORFOLK DISTRICT CORPS OF ENGINEERS
803 FRONT STREET
NORFOLK, VIRGINIA 23510

BY

SCHNABEL ENGINEERING ASSOCIATES, P.C./
J. K. TIMMONS AND ASSOCIATES, INC.

PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I Investigations. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, D. C., 20314. The purpose of a Phase I Investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigation, and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I Investigation; however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. In cases where the reservoir was lowered or drained prior to inspection, such action, while improving the stability and safety of the dam, removes the normal load on the structure and may obscure certain conditions which might otherwise be detectable if inspected under the normal operating environment of the structure.

It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through frequent inspections can unsafe conditions be detected and only through continued care and maintenance can these conditions be prevented or corrected.

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the Spillway Test flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably possible storm runoff), or fractions thereof. Because of the magnitude and rarity of such a storm event, a finding that a spillway will not pass the test flood should not be interpreted as necessarily posing a highly inadequate condition. The test flood provides a measure of relative spillway capacity and serves as an aide in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and the downstream damage potential.

TABLE OF CONTENTS

Name of Dam: Aviation, Golf and Farm Club Dam
State: Virginia
County: Bath
USGS Quad Sheet: Bath Alum
Coordinates: Lat 38° 03.2' Long 79° 43.2'
Stream: Branch of Jordan Run
Date of Inspection: April 16, 1980

BRIEF ASSESSMENT OF DAM

Aviation, Golf and Farm Club Dam is an earthfill structure about 350 ft long and 33.5 ft high. The spillway consists of three outlet pipes extending through the structure. A 36 inch and 15 inch diameter, corrugated metal pipe (CMP) is located at the right abutment, and a 30 inch diameter CMP is located at the left abutment. The outlet pipes discharge into an earth channel. The dam is located on a branch of Jordan Run about 0.25 miles north of Bath Alum, Virginia. The lake is used for recreational purposes and is owned and maintained by Mr. Terrill Brazelton.

Based on criteria established by the Department of the Army, Office of the Chief of Engineers, (OCE), the appropriate Spillway Design Flood (SDF) is the ½ PMF. The spillway will pass less than 10% of the Probable Maximum Flood (PMF) or 20% of the SDF. During the SDF, the dam will be overtopped to a depth of 2.86 ft maximum, at a maximum velocity of 6.6 fps, and will be overtopped for a period of 6 hours. Overtopping is considered detrimental.

Due to the inadequacy of the spillway and the resulting overtopping of the dam during the SDF, and also the lack of stability data, the potential for a breach of the dam exists. Based upon the possibility of a dam breach caused by overtopping during the SDF, the dam is assessed "unsafe, non-emergency".

The classification of "unsafe" applied to a dam because of a seriously inadequate spillway is not meant to connote the same degree of emergency as would be associated with an "unsafe" classification applied for a structural deficiency. It does mean, however, that based on an initial screening, and preliminary computations, there appears to be a serious deficiency in spillway capacity so that if a severe storm were to occur, overtopping and failure of the dam would take place, significantly increasing the hazard to loss of life downstream from the dam.

It is therefore recommended that within two months of the date of notification of the Governor of the Commonwealth of Virginia, the Owner engage the services of a professional engineering consultant to perform necessary studies and design work outlined below:

1) A detailed evaluation of the downstream floodplain and of the Spillway Design Flood appropriate to this dam. Remedial measures to be considered include modification to the dam, spillway, floodplain, and/or any other method of eliminating the danger imposed by the dam.

2) A subsurface investigation and stability analysis should be performed by a Geotechnical Engineer in order to evaluate the stability of the dam and modify as necessary. The widespread seepage observed along the downstream slope should be assessed in this study.

Within six months of the notification of the Governor, the consultant's analyses and recommendations should be completed and the Owner should have an agreement with the Commonwealth of Virginia for a reasonable time period in which all remedial measures will be complete. In the interim, an emergency operation and warning plan should be developed.

An evaluation of the stability condition could not be made since there is no design or construction data for this structure.

The visual inspection revealed several problems. Widespread seepage along the downstream slope is of concern and various stages of erosion were noted in conjunction with the spillway pipes and channels.

The following routine maintenance and observation functions should be initiated as part of an annual maintenance program:

1) The widespread seepage observed along the downstream slope should be monitored quarterly and after periods of high pool level to detect any increase in flow rates which may cause piping within the embankment.

2) The eroded area on the crest of the dam at the 15 inch CMP should be corrected.

3) The outlet channels of the three spillways are eroded and in need of erosion protection at the pipe outlets. Additional protection should be provided for the deeply eroded channel sections in the right abutment near the junction within the stream channel.

4) Vegetation on the dam should be routinely controlled. Grass and weeds should be cut at least once and preferably twice a year.

5) All existing trees or saplings should be cut to the ground. Trees greater than 3 inches in diameter should have their root structures removed. Subsequent holes should be filled with compacted soil and seeded.

6) A staff gage should be installed to monitor water levels.

Prepared by:

SCHNABEL ENGINEERING ASSOCIATES, P.C./
J. K. TIMMONS & ASSOCIATES, INC.

Ray E. Martin, Ph.D., P.E.
Commonwealth of Virginia

Submitted by:

Original signed by.
JAMES A. WALSH

James A. Walsh, P.E.
Chief, Design Branch

Approved:

Original signed by:
Douglas L. Haller

Douglas L. Haller
Colonel, Corps of Engineers
District Engineer

Recommended by:

Original Signed by:
Ronald G. Vann

for Jack G. Starr, P.E., R.A.
Chief, Engineering Division

Date: JUL 2 2 1988

Lake

Dam

OVERVIEW PHOTOGRAPHS

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM
AVIATION, GOLF AND FARM CLUB DAM
VA. NO. 01703

SECTION 1 - PROJECT INFORMATION

1.1 General:

1.1.1 Authority: Public Law 92-367, 8 August 1972, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a national program of safety inspection of dams throughout the United States. The Norfolk District has been assigned the responsibility of supervising the inspection of dams in the Commonwealth of Virginia.

1.1.2 Purpose of Inspection: The purpose is to conduct a Phase I inspection according to the Recommended Guidelines for Safety Inspection of Dams (see Reference 1, Appendix IV). The main responsibility is to expeditiously identify those dams which may be a potential hazard to human life or property.

1.2 Project Description:

1.2.1 Dam and Appurtenances: Aviation, Golf and Farm Club Dam is an earthfill structure approximately 350 ft long and 33.5 ft high.* The top of the dam is 12 ft wide and has a top elevation range from 1667.5 to 1670 msl. Side slopes are approximately 1.6 horizontal to 1 vertical on the downstream side and approximately 2 horizontal to 1 vertical on the upstream side. There is a 10 ft wide private roadway across the top of the dam used for access to approximately six dwellings.

---

* Height is measured from the top of the dam to the downstream toe at centerline of the stream.

It is unknown if the dam is keyed into the foundation or if a drainage system exists. There are no foundation drain outlets. Existing vegetation on the embankment slopes does not provide adequate slope protection.

The principal spillways consist of a 36 inch diameter corrugated metal pipe (CMP) running through the dam at an invert elevation of 1663.5 msl and an additional 15 inch diameter CMP located adjacent to the 36 inch CMP with an invert elevation of 1665 msl. The CMP outlet pipes are located in natural ground at the right abutment, and discharge into earth channels which meander for 50 to 100 ft before dropping abruptly to the natural stream (See Plate No. 2, Appendix I).

An additional spillway is located at the left abutment and consists of a trapezoidal shaped, vegetated earth approach channel with a bottom width of 6 ft and 1.5H:1V side slopes. The earth channel connects to a 30 inch diameter CMP at an invert elevation of 1667± msl. The spillway approach and discharge channel are in a cut at the left abutment (See Plate No. 2, Appendix I).

1.2.2 Location: Aviation, Golf and Farm Club Dam is located on a branch of Jordan Run, 0.25 miles north of Bath Alum, Virginia (See Plate No. 1, Appendix I).

1.2.3 Size Classification: The dam is classified as a "small" size structure because of the dam height.

1.2.4 Hazard Classification: The dam is located in a rural forested area, however, based upon the downstream proximity of four homes located a quarter mile downstream, the dam is assigned a "high" hazard classification. The hazard classification used to categorize a dam is a function of location only and has nothing to do with its stability or probability of failure.

1.2.5 Ownership: The impoundment is owned by Mr. Terrill Brazelton, Warm Springs, Virginia.

1.2.6 Purpose: Recreation.

1.2.7 Design and Construction History: There is no information available concerning the design and construction of this structure. According to Mr. Brazelton, the dam was constructed 50 to 60 years ago.

1.2.8 Normal Operational Procedures: The principal spillways are ungated, therefore, water rising above the invert of the pipe outlets is automatically discharged downstream. Normal pool is maintained at elevation 1666 msl.

1.3 Pertinent Data:

1.3.1 Drainage Areas: The drainage area is 0.93 square miles.

1.3.2 Discharge at Dam Site: Maximum known flood at the dam site occurred in April, 1980, however, high water marks were not observed.

Principal Spillways Discharge (3 outlet pipes):

Pool Elevation at Crest of Dam (elev 1667.5) 55 CFS

1.3.3 Dam and Reservoir Data: See Table 1.1, below:

Table 1.1 DAM AND RESERVOIR DATA

Item	Reservoir				
		Storage			
	Elevation feet msl	Area Acres	Volume Acre Feet	Watershed Inches	Length Miles
Crest of Dam (a)	1667.5	7.5	86	1.7	.2
Principal Spillways					
30" Outlet	1667	7.0	72	1.5	.15
15" Outlet	1665	6.0	58	1.2	.15
36" Outlet	1663.5	5.0	46	0.93	.13
Streambed at Downstream Toe of Dam	1634	—	—	—	—

(a) low point on dam

SECTION 2 - ENGINEERING DATA

2.1 Design: There is no design data available.

2.2 Construction: No construction records are available. The dam is reportedly 50 to 60 years old.

2.3 Evaluation: There is insufficient information to evaluate foundation conditions and embankment stability.

SECTION 3 - VISUAL INSPECTION

3.1 Findings: At the time of inspection, the dam was in fair condition. Field observations are outlined in Appendix III.

3.1.1 General: An inspection was made 16 April 1980 and the weather was clear and windy with a temperature of 50°F. The pool and tailwater levels at the time of inspection were 1666 and 1634 msl, respectively, which correspond to normal levels. Ground conditions were wet at the time of inspection. No previous inspection reports were available.

3.1.2 Dam and Spillway: Both the upstream slope and the downstream slope were covered with brush, briars, and a number of trees up to 12 inches in diameter. Rutting was observed along the crest roadway and severe erosion existed in the roadway in conjunction with the 15" CMP which is one of the principal spillways. Numerous undulations and some scattered surface washes were noted on the downstream slope. The upstream slope included riprap, which appeared to be functioning as planned. Field measurements indicate slopes are 2H:1V on the upstream face and 1.6H:1V on the downstream face. The dam appears to be constructed with assorted combinations of sand, silt, clay, gravel, and boulders. Considerable seepage was observed along the basal 3 to 5 ft of the downstream toe while saturated conditions existed 5 to 10 ft above the lowest point on the downstream slope. Additional seepage was encountered along the left embankment abutment. Contact seepage areas are illustrated on field sketch, Sheet 1 of Appendix III.

The right abutment includes exposures of large gray sandstone blocks. No bedding was observed and it could not be verified whether this represents bedrock or talus. Numerous groundhog holes exist along the right abutment slope. Black shale chips were exposed in a graded area behind the existing treatment pond, below the left abutment. No faults were observed in the field during this inspection and geologic maps of the area do not show the presence of faults in the immediate vicinity.

The spillway outlet pipes of the principal spillway showed no signs of deterioration, however, the outlet channels for these pipes were eroded at the plunge pool area due to a lack of riprap. The lower end of the outlet channels were badly eroded and include approximately 20 ft vertical drops in their channels in approximately a 5 ft horizontal distance. See the field sketch, Sheet 2, Appendix III.

At the left abutment the spillway approach channel had vegetative protective growth and the 30 inch CMP outlet showed no signs of deterioration. The outlet channel of the emergency spillway was not well defined and showed some erosion immediately below the outlet pipe.

3.1.3 Reservoir Area: The reservoir area was free of debris and the perimeter was wooded. The reservoir is located in a shallow valley with side slopes at approximately 2H:1V to 3H:1V. No sediment buildup was visually detected near the intake structure.

3.1.4 Downstream Area: The downstream channel is about 50 ft wide and has side slopes ranging from 1H:1V to vertical. The area is heavily wooded. Approximately one quarter mile downstream there are four dwellings adjacent to the flood plain. Two of the dwellings have floor elevations less than 10 ft above the streambed.

3.1.5 Instrumentation: No instrumentation (monuments, observation wells, piezometers, etc.) was encountered for the structure.

3.2 Evaluation:

3.2.1 Dam and Spillway: Overall, the dam was in fair condition at the time of inspection. Based upon the appearance of the dam and amount of vegetation growing on the embankment at the time of the inspection and according to the Owner, there is no routine maintenance program for this structure. Uncontrolled growth promotes the development of deep rooted vegetation and this type of growth can encourage piping within the embankment. Also, excessive growth inhibits effective visual inspections of the dam. If a routine maintenance program does not exist, one should be initiated. The embankment, including its crest, slopes, and emergency spillway, should be mowed at least once a year, but more preferably twice a year. Trees presently growing on the embankment should be cut to the ground. Trees greater than 3 inches in diameter should have their stumps and root structures removed. Subsequent holes should be filled with compacted soil and seeded.

The wet spots and iron-stained seepage encountered along the lower portion of the downstream slope represent seepage through the dam. The seepage appears to be rather uniform across the downstream slope and no turbidity was noted during the inspection. Flow rates were generally less than 1 gpm. This widespread seepage is of concern and it is recommended that the seepage along the downstream slope be monitored quarterly to detect any increase in flow rates which may cause piping within the embankment. If increased flows should occur,

a qualified Professional Engineer with expertise in Geotechnical Engineering should be contacted to evaluate the problem and make recommendations for required corrective measures.

The outlet pipes of the principal and emergency spillway are in good condition, however, the outlet channels of the spillways are eroded and in need of erosion protection at the pipe outlets. The principal spillway outlet channels in the right abutment need additional erosion protection at the abrupt vertical change in their profiles at the junction with the stream channel.

The eroded area exposed on the crest of the dam at the 15 inch CMP should be corrected.

A staff gage should be installed.

3.2.2 Downstream Area: The existing dwellings downstream could be jeopardized by a breach in the dam during periods of peak flooding.

SECTION 4 - OPERATIONAL PROCEDURES

4.1 Procedures: Aviation, Golf and Farm Club Reservoir is used for recreational purposes. The normal pool elevation (1666 msl) is controlled by the invert of the lowest outlet pipe. Water automatically flows through the outlet pipes when the pool level rises above the invert of the pipes. Water flows through the 36 inch outlet pipe at elevation above 1663.5 msl, through the 15 inch outlet pipe at pool elevations above 1665 msl, and through the 30 inch outlet pipe at pool elevations above 1667 msl. There is no method of lowering the pool below elevation 1663.5 msl.

4.2 Maintenance of Dam and Appurtenances: Maintenance is the responsibility of the Owner. Maintenance consists of inspection, debris removal, some mowing of the vegetative cover and repair, however, there is no routine maintenance program. There are no valve-operated appurtenances.

4.3 Warning System: No warning system exists.

4.4 Evaluation: Maintenance of the dam is considered inadequate. A routine maintenance program should be established and complete records of maintenance and inspections should be maintained for future reference. An emergency operation and warning plan should be developed. It is recommended that a formal emergency procedure be prepared and furnished to all operating personnel. This should include:

a) How to operate the dam during an emergency.

b) Who to notify, including public officials, in case evacuation from the downstream area is necessary.

SECTION 5 - HYDRAULICS/HYDROLOGIC DATA

5.1 Design: No hydraulic/hydrologic data is available.

5.2 Hydrologic Records: There are no records available.

5.3 Flood Experience: An estimated maximum pool elevation occurred in April 1980, according to the Owner.

5.4 Flood Potential: In accordance with the established guidelines, the spillway design flood is based on the estimated "Probable Maximum Flood" for the region (flood discharges that may be expected from the most severe combination of critical meteorologic and hydrologic conditions that are reasonably possible in the region), or fractions thereof. The Probable Maximum Flood (PMF) and ½ PMF hydrographs were developed by the SCS method (Reference 4, Appendix IV). Precipitation amounts for the flood hydrographs of the PMF are taken from the U. S. Weather Bureau Information (Reference 5, Appendix IV). Appropriate adjustments for basin size and shape were accounted for. These hydrographs were routed through the reservoir to determine maximum pool elevations.

5.5 Reservoir Regulation: For routing purposes, the pool at the beginning of flood was assumed to be at elevation 1666 msl. Reservoir stage-storage data and stage-discharge data were determined from field measurement and USGS quadrangle sheets. Floods were routed through the reservoir using the principal and emergency spillway discharge up to a pool storage elevation of 1668 msl and a combined spillway and non-overflow section discharge for pool elevations above 1668 msl.

5.6 Overtopping Potential: The predicted rise of the reservoir pool and other pertinent data were determined by routing the flood

hydrographs through the reservoir as previously described. The results for the flood conditions (½ PMF and PMF) are shown in the following Table 5.1.

TABLE 5.1 RESERVOIR PERFORMANCE

	Normal Flow	Hydrograph ½ PMF	Hydrograph PMF
Peak Flow, CFS			
Inflow	6	3767	7534
Outflow	6	3767	7534
Maximum Pool Elevation Ft, msl	-	1670.86	1672.2
Non-Overflow Section (Elev 1667.5 msl)			
Depth of Flow, Ft	-	3.36	4.7
Duration, Hours	-	6	6.5
Velocity, fps (a)	-	6.6	8.0
Tailwater Elevation, Ft, msl	1634	1644	1649

(a) Critical velocity at control section

5.7 Reservoir Emptying Potential: There is no method of emptying the reservoir below the principal spillway invert.

5.8 Evaluation: The Army Corps of Engineers guidelines indicate the appropriate spillway design flood (SDF) for a small size "high" hazard dam is the ½ PMF to 100 year flood. Because of the risk involved, the ½ PMF has been selected as the SDF. The spillway will pass less than 10 percent of the PMF (20% of the SDF). The SDF will overtop the dam a maximum of 3.36 ft at the low point, and remain above the dam for 6 hours with a maximum critical velocity of 6.6 fps.

Hydrologic data used in the evaluation pertains to present day conditions with no consideration given to future development.

SECTION 6 - DAM STABILITY

6.1 Foundation and Abutments: The dam is located within the Valley and Ridge Physiographic Province of Virginia. The impoundment and structure are located near the contact between the Oriskany Sandstone and Romney Shale, both of Devonian age. The Oriskany consists basically of gray to white, coarse calcareous sandstones. The younger Romney shales range from black to green in color and include some sandstone beds. Bedrock exposed along Thompson Creek, just south of the site, strikes to the northeast and dips from vertical to very steeply to the southeast. Available geologic maps indicate the impoundment may rest upon the east link of an anticlinal structure. No faults were observed at the site. Black shale was exposed in the left abutment area, behind the sewage lagoon. Large sandstone blocks were exposed in the right abutment area. It could not be confirmed whether these blocks represent bedrock or talus materials from surrounding slopes.

Subsurface data is not available for the structure. It is not known whether a cutoff trench exists beneath the dam. Based upon examination of surrounding hillsides and cuts, it would appear that the dam may rest in part on colluvial and/or alluvial soils consisting of assorted mixtures of sand, silt, and clay with variable amounts of gravel and boulders. Expected permeabilities would range from low to high. Underlying residual soils derived from the Romney shale would probably consist of silty clays and clayey silts possessing low to medium permeabilities.

Gradual consolidation of underlying soils would be expected during application of fill materials. The underlying soils probably

had essentially fully consolidated under the applied load not long after completion of construction. Based upon the performance history of this dam, a stable foundation is assumed.

6.2 Embankment:

6.2.1 Materials: There is no information available on the nature of the embankment materials. The surface of the embankment appears to be constructed with assorted combinations of sand, silt and silty clay ranging from SM to SC in composition and including an indeterminant amount of gravel and boulders. Low to high permeabilities are likely for these materials.

6.2.2 Subdrains and Seepage: There is no known drainage system and apparently no toe drain outlets. Saturated or wet and iron-stained areas encountered along the downstream slope represent seepage through the dam.

6.2.3 Stability: There are no stability calculations for this structure. The dam is 33.5 ft high and has a crest width of 12 ft. The upstream slope is approximately 2H:1V, while the downstream slope varies to about 1.6H:1V.

Although the type materials used during construction cannot be confirmed visually, it is assumed the structure is homogeneous and constructed with SC to SM soils. According to the guidelines present in Design of Small Dams, U. S. Department of the Interior Bureau of Reclamation, for small homogeneous dams with a stable foundation not subjected to drawdown and composed of SC to SM materials, the recommended slopes range from 2H:1V to 2.5H:1V for the downstream and upstream slopes respectively. Based upon existing slopes of 2H:1V for the

upstream slope and 1.6H:1V for the downstream slope, both slopes are considered to be inadequate. The recommended crest width is 17 ft, therefore, the existing crest width is also considered to be inadequate.

6.2.4 Seismic Stability: The dam is located in Seismic Zone 2. Therefore, according to the Recommended Guidelines for Safety Inspection of Dams, the dam is considered to have no hazard from earthquakes provided static stability conditions are satisfactory and conventional safety margins exist.

6.3 Evaluation: An accurate check on the stability of this structure cannot be made since there is no design and construction data. Foundation conditions are not known and the embankment slopes and crest width do not meet the requirements recommended by the U. S. Bureau of Reclamation for small homogeneous earthfill dams on stable foundation. Overtopping is considered a problem because of the depth and duration of flood and also the velocity is greater than 6 fps, the effective eroding velocity for a vegetated earth embankment. Therefore, it is recommended that the Owner retain the services of a qualified Professional Engineer with expertise in Geotechnical Engineering to evaluate the stability of the dam. Since no undue settlement, cracking, sloughing or seepage was noted at the time of inspection, it appears that the embankment is adequate for maximum control storage with water at elevation 1667 msl. As previously stated, the iron-stained saturated areas observed along the toe of the downstream slope are believed to represent seepage through the embankment and are of concern. It is recommended that these areas be monitored quarterly to detect any increase in flow rates which could result in piping through the embankment.

SECTION 7 - ASSESSMENT/REMEDIAL MEASURES

7.1 Dam Assessment: The Aviation, Golf and Farm Club Dam at the time of inspection appeared to be in fair condition. The appropriate SDF for this dam is ½ PMF. The spillway will pass less than 10 percent of the PMF (20 percent of the SDF) without overtopping, and the dam will be overtopped by 3.36 ft during the SDF. The spillway is judged seriously inadequate.

There are no design or construction records available for this structure, therefore, an accurate check on its stability cannot be made. Flows overtopping the dam are considered detrimental with respect to erosion.

Only a limited maintenance program exists for the structure and maintenance is considered inadequate.

Due to the inadequacy of the spillway and the resulting overtopping of the dam during the SDF, and also the lack of stability data, the potential for a breach of the dam exists. Based upon the possibility of a dam breach caused by overtopping during the SDF, the dam is assessed "unsafe, non-emergency".

The classification of "unsafe" applied to a dam because of a seriously inadequate spillway is not meant to connote the same degree of emergency as would be associated with an "unsafe" classification applied for a structural deficiency. It does mean, however, that based on an initial screening, and preliminary computations, there appears to be a serious deficiency in spillway capacity so that if a severe storm were to occur, overtopping and failure of the dam would take place, significantly increasing the hazard to loss of life downstream from the dam.

7.2 Recommended Remedial Measures: It is recommended that within two months of the date of notification of the Governor of the Commonwealth of Virginia, that the Owner engage the services of a professional engineering consultant to complete the following action:

1) A detailed evaluation of the downstream floodplain and of the Spillway Design Flood appropriate to this dam. Remedial measures to be considered include modification to the dam, spillway, floodplain, and/or any other method of eliminating the danger imposed by the dam.

2) A subsurface investigation and stability analysis should be performed by a Geotechnical Engineer in order to evaluate the stability of the dam and modify as necessary. The widespread seepage observed along the downstream slope should be assessed in this study.

Within six months of the notification of the Governor, the consultant's report of appropriate remedial mitigating measures should have been completed and the Owner should have an agreement with the Commonwealth of Virginia for a reasonable time frame in which all remedial measures will be complete.

Until corrective measures are completed, the dam should be checked during periods of heavy runoff. If dam overtopping is imminent, warning should be issued to the downstream inhabitants.

In the interim, an emergency operation and warning plan should be promptly developed. It is recommended that a formal emergency procedure be prepared, prominently displayed, and furnished to all operating personnel. This should include:

1) How to operate the dam during an emergency.

2) Who to notify, including public officials, in case evacuation from the downstream area is necessary.

7.3 Required Maintenance and Observation:

7.3.1 Widespread seepage present along the downstream slope should be monitored quarterly and after periods of high pool levels in the reservoir to detect any increases in flow rates which may cause piping within the embankment.

7.3.2 The eroded area exposed on the crest of the dam at the 15 inch CMP should be corrected.

7.3.3 The outlet channels at the three spillway pipes are eroded and in need of erosion protection at the pipe outlets. Additional protection should be provided for the deeply eroded channel sections in the right abutment near their junctions with the stream channel.

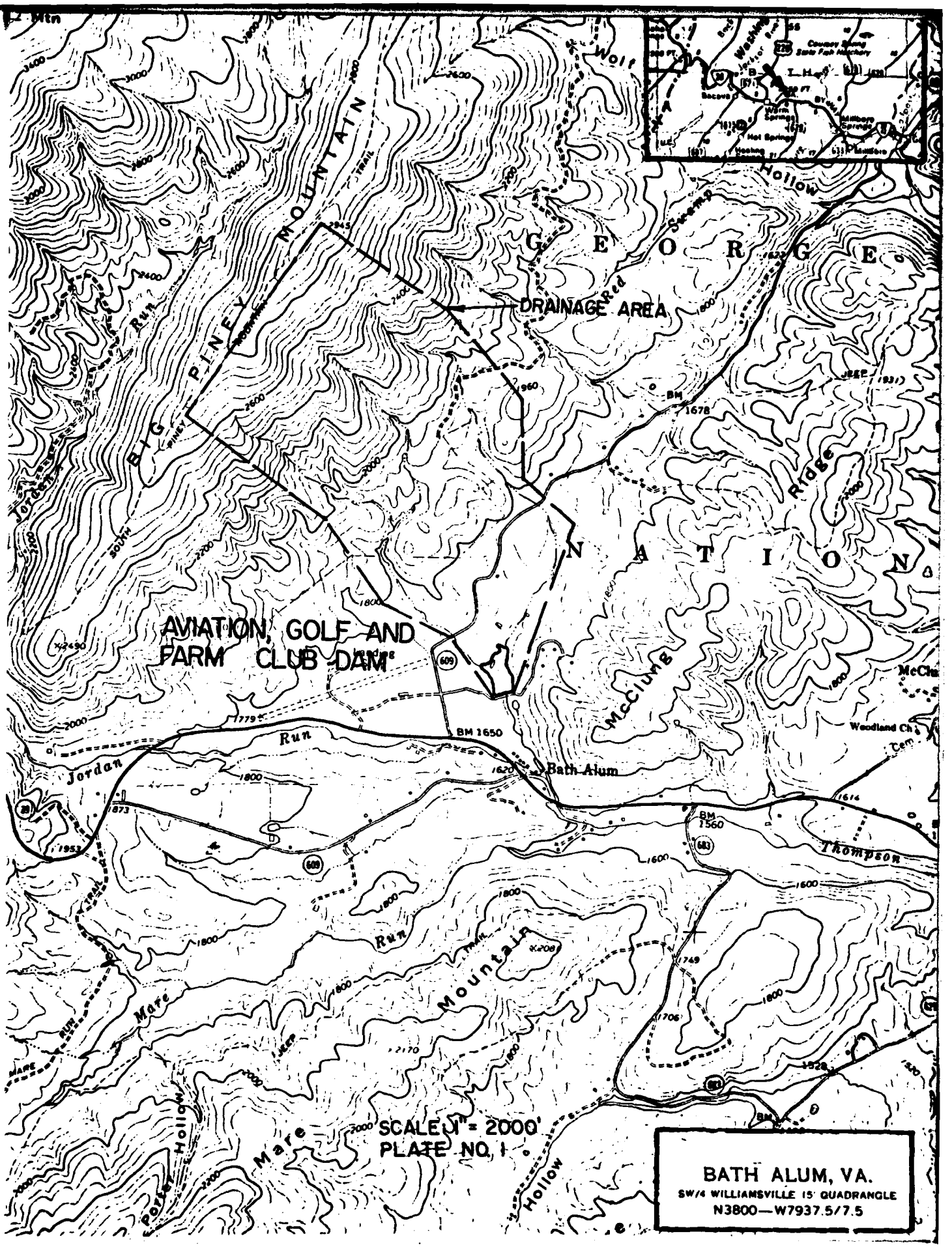
7.3.4 The grass and weeds on the embankment should be cut at least once and preferably twice a year. We would recommend maintenance in the early summer and fall.

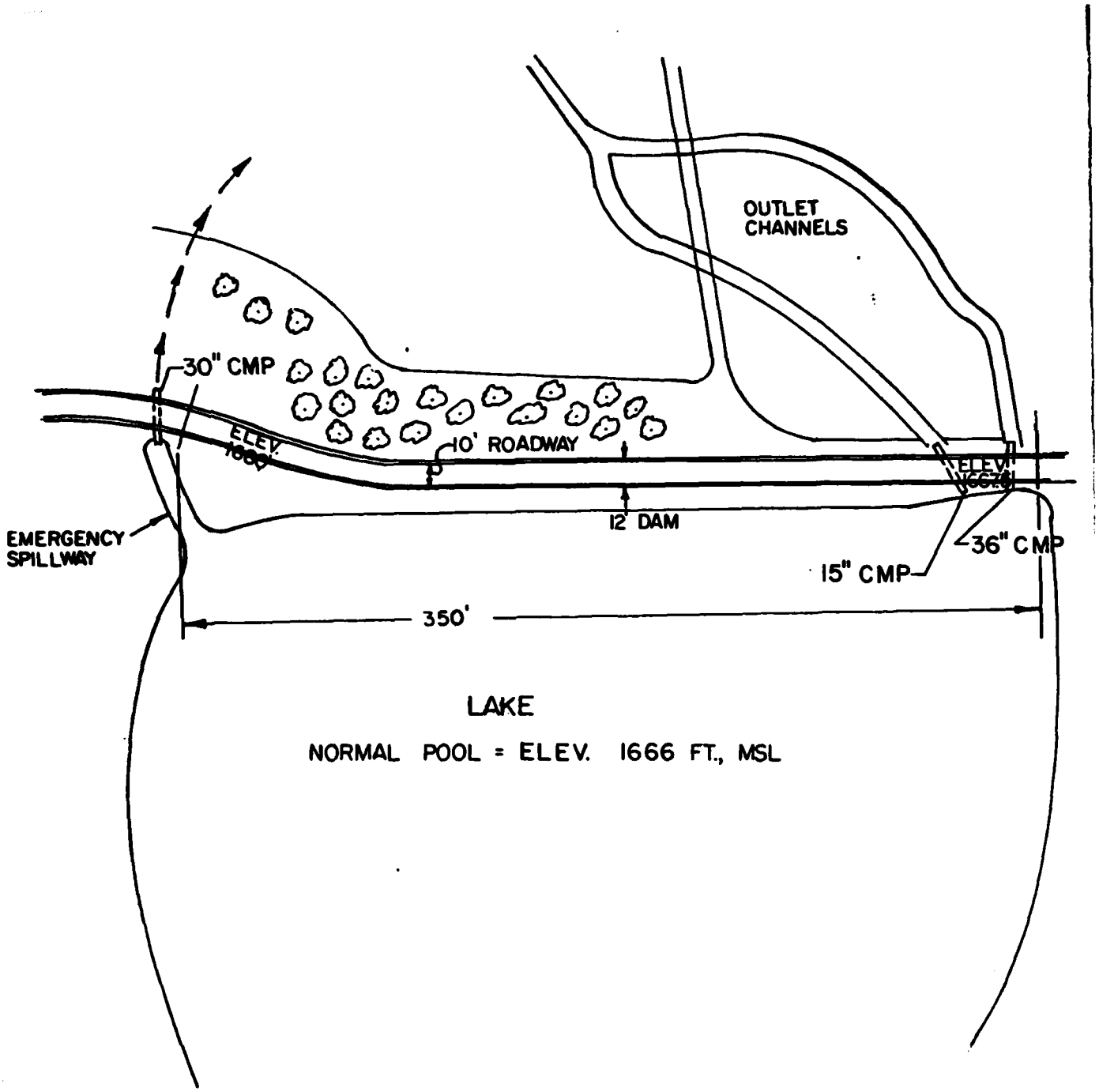
7.3.5 All trees and saplings present on the embankment should be cut to ground level yearly during maintenance operations. Trees greater than 3 inches in diameter should have their root structures removed. Subsequent holes should be filled with compacted soil and seeded.

7.3.6 A staff gage should be installed to monitor water levels.

APPENDIX I

MAPS AND DRAWINGS


DRAINAGE AREA
AVIATION, GOLF AND FARM CLUB DAM
BIG PINEY MOUNTAIN
GEORGE
NATION
Ridge
Hollow
Run
Jordan
McClung
Thompson
Mare
Mountain
Bath Alum
BM 1650
BM 1678
BM 1560
SCALE 1" = 2000'
PLATE NO. 1
BATH ALUM, VA.
SW/4 WILLIAMSVILLE 15' QUADRANGLE
N3800—W7937.5/7.5



PLAN

AVIATION, GOLF, AND FARM CLUB
DAM

FIELD SKETCH

PLATE NO. 2

APPENDIX II

PHOTOGRAPHS

Inlet to 36 Inch and 15 Inch Outlet Pipe

Photograph No. 1

Outlet Channel for 36 Inch Outlet Pipe

Photograph No. 2

Downstream 36 Inch Pipe Outlet Channel

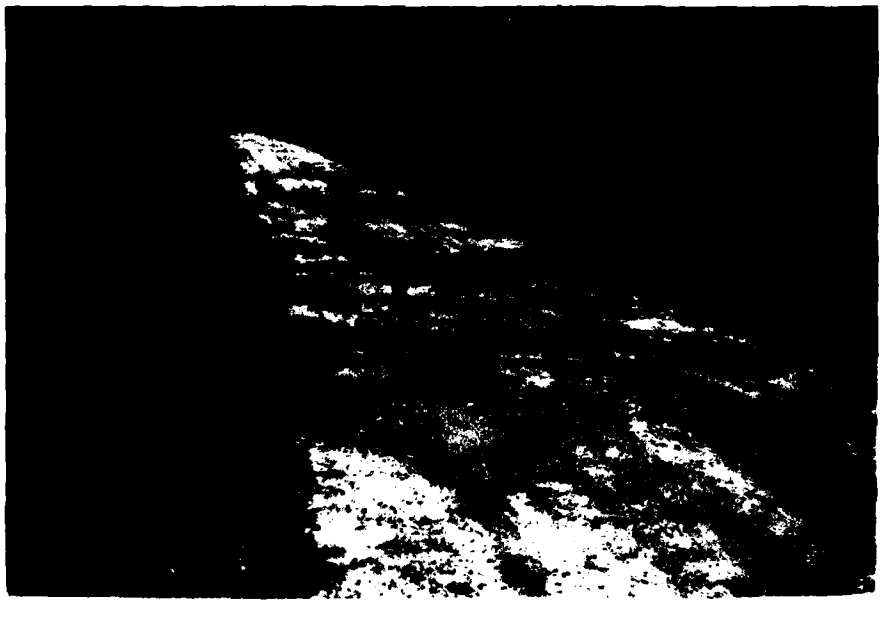
Photograph No. 3

Erosion Around 15 Inch Outlet Pipe

Photograph No. 4

Downstream Face of Dam

Photograph No. 5



Roadway Across Top of Dam

Photograph No. 6

30 Inch Outlet Pipe Approach Channel

Photograph No. 7

Downstream Dwelling

Photograph No. 8

APPENDIX III

FIELD OBSERVATIONS

Check List
Visual Inspection
Phase I

Name Dam Aviation, Golf, and Farm Club Dam County Bath State Virginia Coordinators Lat 38°-03.2' Long 79°-43.2'

Date(s) Inspection 4/16/80 Weather Clear, windy Temperature 50°F

Pool Elevation at Time of Inspection 1666 msl Tailwater at Time of Inspection 1634 msl

Inspection Personnel:

Schnabel Engineering Associates, P.C.
Raymond A. DeStephen, P.E.
Stephen G. Werner, (recorder)

J. K. Timmons and Associates, Inc.
Robert G. Roop. P.E.
Donald Balzer, (recorder)

State Water Control Board
Hugh M. Gildea, P.E.

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS	The slopes, crest, emergency spillway and abutment contacts were inspected and no cracks were noted. Both the upstream and downstream slopes were covered with brush, briars, and a number of trees up to 12 inches in diameter.	
UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE	No unusual movements or cracking were noted on the dam or downstream beyond the embankment toe.	
SLOUGHING OR EROSION OF EMBANKMENT AND ABUTMENT SLOPES	No serious erosion was noted on the embankment. Rutting exists along the crest roadway. Numerous undulations exist along the downstream slope as well as some scattered surface erosion. Abundant rock was exposed along the downstream slope. Dam appears to be constructed with sand, silt, clay, gravel, and boulders. The upstream slope is 2H:1V±, while the downstream slope is 1.6H:1V±. Severe erosion was noted in the roadway in conjunction with a 15 inch CMP outlet pipe. Two areas of erosion were also observed in conjunction with the outlet channels. See accompanying field sketch, Sheet 2.	
VERTICAL AND HORIZONTAL ALINEMENT OF THE CREST	The vertical and horizontal alignment of the dam appeared to be good.	
RIPRAP FAILURES	Riprap was present on the upstream slope and appeared to be functioning properly.	

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
JUNCTION OF EMBANKMENT AND ABUTMENT, SPILLWAY AND DAM	The right abutment includes exposures of large gray sandstone blocks. No bedding was observed and it could not be verified whether this represents bedrock or talus. Numerous groundhog holes exist along the right abutment slope. Black shale chips were exposed in a graded area behind the treatment pond, below the left abutment. The embankment appears to tie in well with the adjacent abutments. No faults were observed in the field during this inspection.	
ANY NOTICEABLE SEEPAGE	Considerable seepage with accompanying iron staining was observed along the toe of downstream slope. Seepage was present along the basal 3 to 5 ft while saturated conditions existed 5 to 10 ft above the lowest point of the downstream slope. Additiona seepage was located along the edge of the left abutment. See the accompanying field sketch, Sheet 1.	
STAFF GAGE AND RECORDER	None observed.	
DRAINS	None observed.	

EMERGENCY SPILLWAY

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
WEIR	30 inch CMP with invert 1 ft above normal pool.	Good condition
APPROACH CHANNEL	6 ft wide with 2:1 side slopes, grass lined.	Good condition
DISCHARGE CHANNEL	In natural ground; undefined channel with some erosion immediately below the outlet pipe.	Riprap protection should be placed at pipe outfall.
BRIDGE AND PIERS	None	-

OUTLET WORKS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CRACKING AND SPALLING OF CONCRETE SURFACES IN OUTLET CONDUIT	36 inch and 15 inch CMP	Good condition
INTAKE STRUCTURE	None	-
OUTLET STRUCTURE	None	-
OUTLET CHANNEL	Outlet channel consists of two earth channels approximately 1 ft deep with channel bottom 2 ft and 6 ft wide, respectively. Minor erosion has occurred at the pipe outlets to the channels and severe erosion has occurred where the outlet channels drop. 20 ft± to the natural stream in 5 ft± horizontally. See Sheet 2	Riprap needed in channels.
EMERGENCY GATE	None	-

RESERVOIR

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SLOPES	Slight to moderate slopes up to 2½ H:1V bound the immediate reservoir area. The area is vegetated with grass, brush, and trees. The shoreline is in good condition.	
SEDIMENTATION	None	Water is very clear.

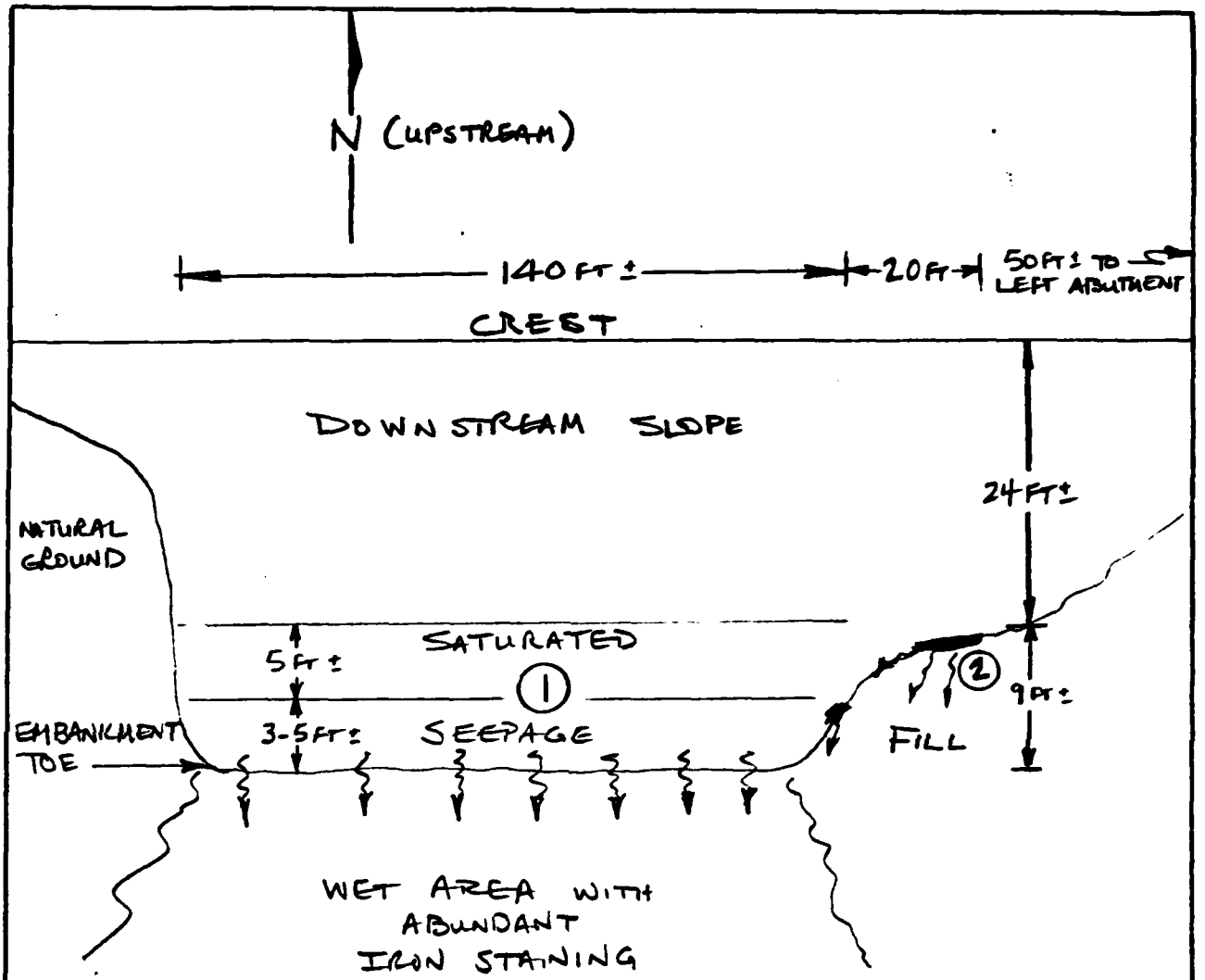
DOWNSTREAM CHANNEL

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONDITION (OBSTRUCTIONS, DEBRIS, ETC.)	Minor debris and heavily wooded, with a roughness factor of N = 0.1. Bottom width is 50 ft. Heavy erosion where outlet channels intercept natural stream.	Repairs needed where outlet channels are eroded.
SLOPES	Moderately steep to steep (vertical to 1:1) stable, wooded slopes bound the downstream channel.	
APPROXIMATE NO. OF HOMES AND POPULATION	Four homes with possible hazard. Two homes are within 10 ft of stream elevation.	

INSTRUMENTATION

VISUAL EXAMINATION	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
MONUMENTATION/SURVEYS	None	-
OBSERVATION WELLS	None	-
WEIRS	None	-
PIEZOMETERS	None	-
OTHER	None	-

BY SW DATE 4/16/80 **SCHNABEL ENGINEERING ASSOCIATES** SHEET NO. 1 OF 2
CHKD. BY ..... DATE ..... **CONSULTING ENGINEERS** JOB NO. VB0102
SUBJECT FIELD SKETCH – SEEPAGE AREAS



(1) SEEPAGE CONCENTRATED IN BASAL 3-5 FT ± WITH SCATTERED FLOW AT LESS THAN 1 GPM. SATURATED SLOPE APPROXIMATELY 5 FT WIDE EXISTS ABOVE THE BASAL AREA.

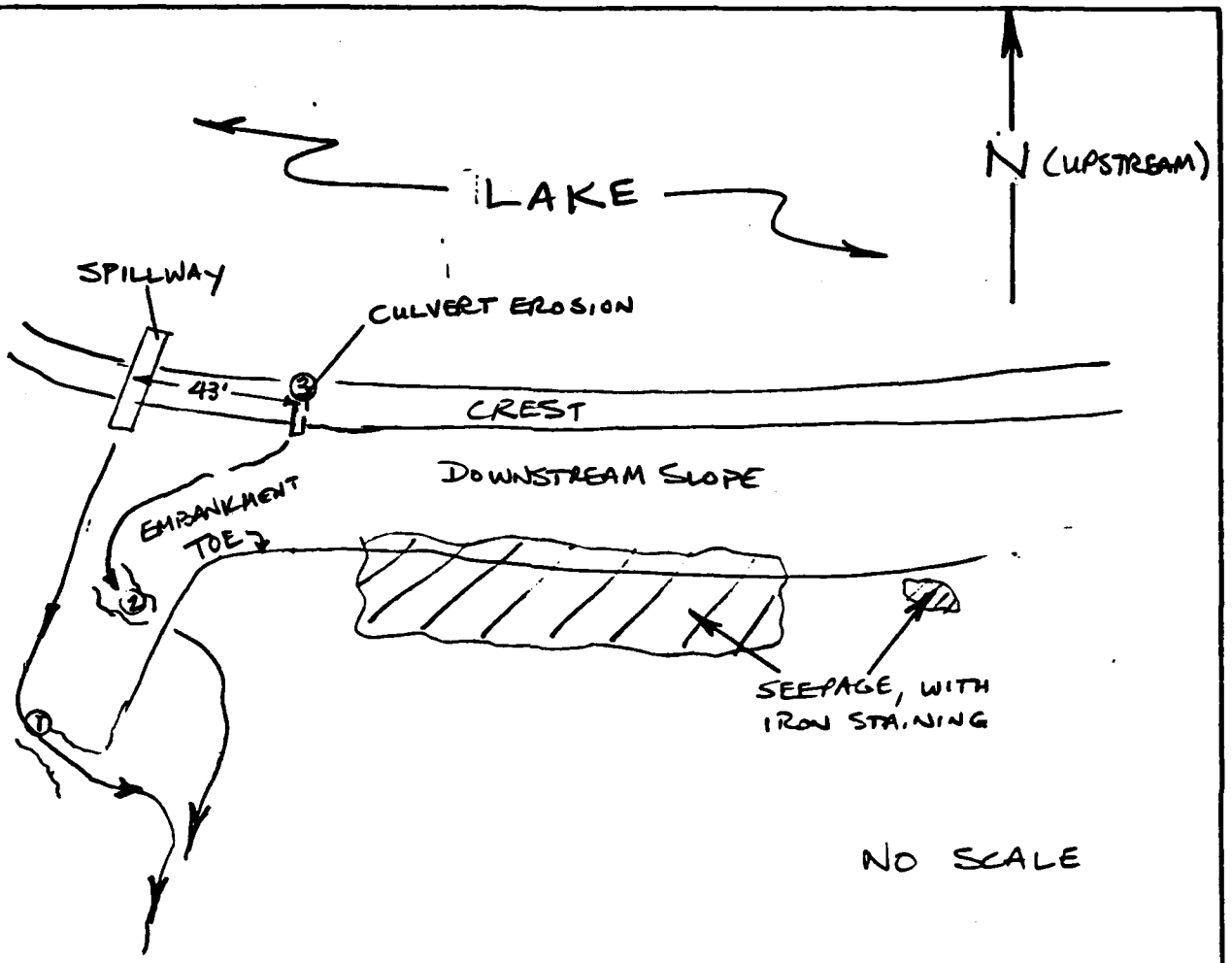
(2) AREA OF LOCALIZED SEEPAGE ; 20 FT ± LONG AND 5 FT ± WIDE WITH ABUNDANT IRON STAIN. OBSERVED FLOW LESS THAN 1 GPM.

NO SCALE

BY SW DATE 4/16/80 **SCHNABEL ENGINEERING ASSOCIATES** SHEET NO. 2 OF 2

CHKD. BY ..... DATE ..... **CONSULTING ENGINEERS** JOB NO. V80102

SUBJECT FIELD SKETCH — ERODED AREAS



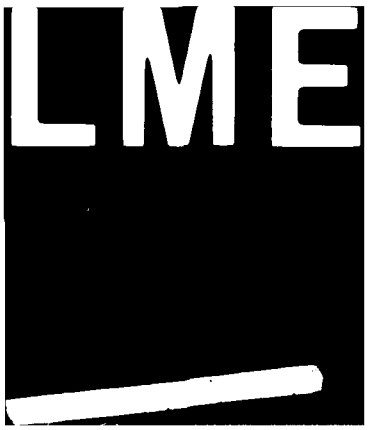
① ERODED AREA IN MAIN SPILLWAY CHANNEL; 20-25 Ft ± WIDE, 15 FT ± DEEP. PRESENTLY UNDERMINING A LARGE TREE BOUNDING THE NORTH SIDE OF CHANNEL.

② ERODED AREA OFF MAIN CHANNEL; 10-20 Ft ± WIDE AND 15 Ft ± DEEP. FILLED IN PART WITH LARGE BLOCKS OF ROCK

③ EROSION . FROM EDGE OF POOL TO POINT 7 FT ± INWARD. ERODED AREA IS 7 FT ± LONG, 3 FT ± WIDE AND 4 FT ± DEEP. EROSION IS AROUND 16" ± CMP

APPENDIX IV - REFERENCES

1. Recommended Guidelines for Safety Inspection of Dams, Department of Army, Office of the Chief of Engineers, 46 pp.
2. Design of Small Dams, U. S. Department of Interior, Bureau of Reclamation, 1974, 816 pp.
3. Geology of the Appalachian Valley in Virginia, Bulletin No. 52 (Part 1), Charles Butts, Virginia Division of Mineral Resources, 1940, 568 pp.
4. Section 4, Hydrology, Part 1, Watershed Planning, SCS National Engineering Handbook, Soil Conservation Service, U. S. Department of Agriculture, 1964.
5. Hydrometerologic Report No. 33, U. S. Department of Commerce, Weather Bureau, U. S. Department of Army, Corps of Engineers, Washington, D. C., April 1956.
6. Technical Paper No. 40, U. S. Department of Commerce, Weather Bureau, Washington, D. C., May 1961.


LME